ON SOME RIFT-LIKE FEATURES OF THE LITTLE HUNGARIAN PLAIN

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(Received 8th September, 1959)

SUMMARY

The morphological, tectonical, volcanological and geophysical properties of the Little Hungarian Basin and the African rifts are compared. The Little Hungarian Basin is found to be a rift-like feature, smaller and more ancient than the African rifts.

In a paper of this volume, E g y e d (1) has given a hypothesis of development of the African rifts and the Red Sea. He derived this hypothesis from facts of observation as described by G i r d l e r (2) and from his own hypothesis of over-all Earth expansion. It is an interesting problem to see whether the rifting due to tensile stresses is as general a phenomenon as would be postulated by an over-all expansion of the Earth.

In Europe, the Mediterranean-Mjösen zone of roughly north-south strike has been mentioned by S t i l l e (3) as a feature much resembling the African rifts. My attention has been called by E g y e d (personal communication) to the fact that in some geophysical respects the Little Hungarian Plain, too, resembles the African rifts. It is intended in this paper to make a comparative study of these two areas, in order to determine whether it is possible for a rift-like feature to develop in a geological environment so much differing from the African one.

The Little Hungarian Plain lies along the Western boundary of the country. It has an extension of about 120 kilometres in length and 50 kilometres in width. Its axis is delineated by the Rába River. On the west it is bordered by the forerunners of the Alps, which mostly lie on Austrian territory; on the east it is in a section bordered by the Bakony Mountains, elsewhere it changes gradually into a country of undulating topography. This latter is the case also in the south.

From the point of view of crustal structure this rift-like feature is of greater extension than indicated by basin topography. A crustal thickness chart of Transdanubia (4) shows that the Little Hungarian Plain is part of a longer belt of rather small crustal thickness of 20 kilometres on the average. In the following, we will extend our investigation to this entire zone.

The comparison between the properties of African rifts and of the Little Hungarian Plain will be extended to morphological, tectonical, volcanological and geophysical characteristics.

1. As regards morphology, the width-to-depth relation of the African rifts is (2) between 35:1 and 70:1. In the case of the Little Hungarian Basin this value is about 100:1, if the present-day surface is considered. However, if we consider the Meso-Palaeozoic basement and disregard the superincum-

bent Miocene and younger sediments, this ratio is 35:1 on the average. As to the ratio of width to length, the Hungarian area considered is much shorter than the African rifts. The possible causes of its small length are the bordering mountain chains of the Carpathians in the north and the Dinarid ranges in the south.

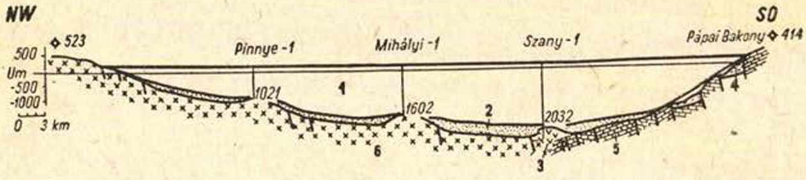

Fig. **1**. Geological profile through the Little Hungarian Plain, after Kőrössy
1. Pannonian sedimentary filling, 2. Miocene, 3. Cenozoic volcanics, 4. Palaeogene, 5. Mesozoic, 6. Crystalline

2. As regards tectonics, the African rifts are characterized by normal faulting. It is a much contested problem whether these faults were caused by compressive or tensile stresses. However, the point in the present case is that normal faults are readily observable on both sides of our area, too, as shown in profiles by Kőrössy (5). The analysis of geological profiles indicates that these were caused by stresses which were tensile at least in the upper, geologically observable part of the crust. Along these faults, the mountain masses of the Alps and the Bakony Mountains sink to a depth of 2000 to 4000 metres below sea level. In the axis of the Bakony Mountains, the bottom of the plain is at a smaller depth than further north or south, so that in this area the bottom has a saddle-surface-like shape. South of this underground ramp there occur areas where the Meso-Palaeozoic basement has not been reached by borings 4000 metres deep. Consequently, the geological profile and the tectonics can be said to resemble that of the African rifts, with the difference that the sedimentary filling is much more complete and consists of much older sediments on the average (Helvetian to Pleistocene).

3. The African rifts are known to be characterized by recently extinguished and even still active alkali basaltic volcanism. The assumption of Girdler (2) by which he explained the magnetic and gravity anomaly of the Red Sea was the surge of a basic magmatic mass along the sea axis. He proved his assumption by mentioning some small islands of alkali basalt projecting above the sea surface. Just like that, some cones of alkali basalt are projecting above the surface of the young sediments in the Little Hungarian Basin area. Along the rim, and further off, there occur lava flows and greater cones of basalt in the Bakony Mountains and Austria. These rocks are alkalic in composition, just as the ones along the African rifts. Their age is Pliocene, also somewhat older than the bulk of volcanism along the African rifts.

4. In the geophysical respect, we wish to compare *a)* gravity, *b)* magnetic, *c)* heat flow and *d)* seismicity data.

a) The African rifts are characterized by negative isostatic anomalies, except the Red Sea, in the central part of which the anomalies become positive. In Hungary, the isostatic and Bouguer anomaly values are very much resembling each other. Therefore, for comparison, we will utilize the more detailed Bouguer anomaly map (6). This shows a none too well-defined minimum roughly coinciding with the axis of our area. Superimposed on the minimum are some smaller maxima, due to buried hills of Palaeozoic crystalline rocks, whose existence was proved by borings. The average value of the gravity deficit as related to the surrounding mountains is some 20 milligals.

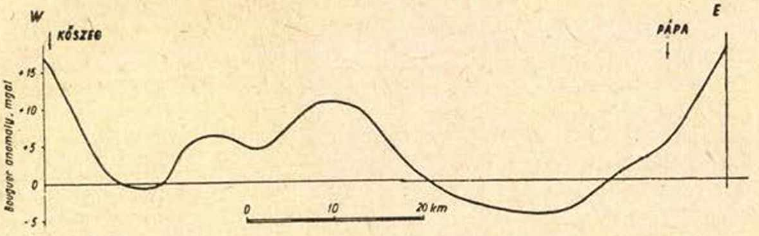

Fig. **2.** Gravity profile through the Little Hungarian Plain

This is rather less than was found for the African rifts. However, if the sedimentary filling should be removed, the anomaly would rise to several times its present value. Thus the differences in the gravity profile may to some extent be due to the sedimentary filling. The gravity differences between

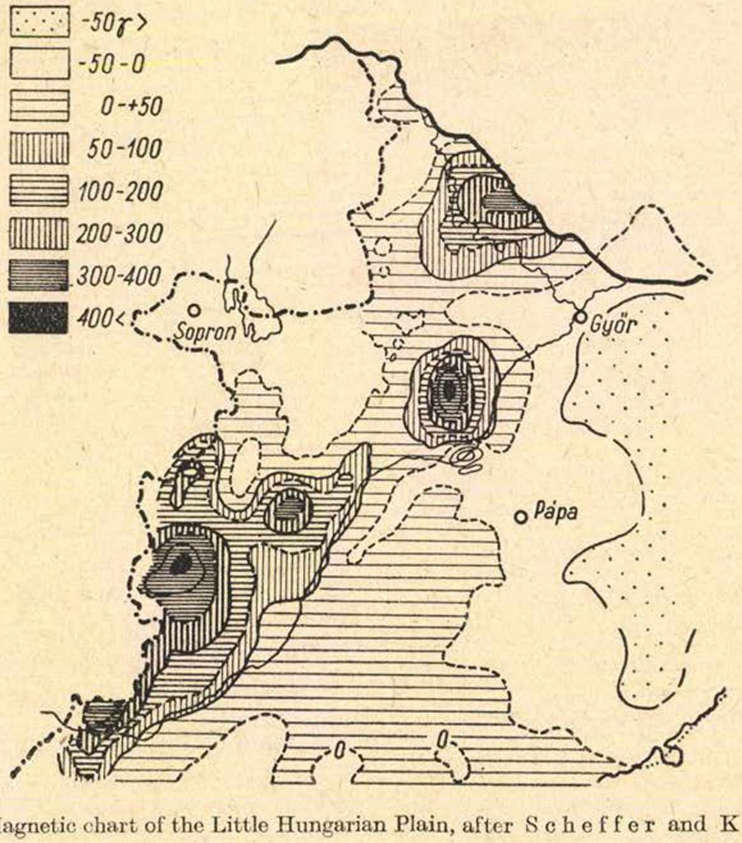

Fig. **3.** Magnetic chart of the Little Hungarian Plain, after S c h e f f e r and K á n t á s parts of the African rift system are by Girdler (2), too, considered to be due to differences in sedimentary filling.

b) Along the Red Sea axis, Girdler has demonstrated a sharp magnetic anomaly he identified with the influence of a basic magmatic mass. — There is a magnetic anomaly with peak values of some hundred gammas cutting obliquely through our area. This has been assumed to be due to a basic magmatic body by Scheffer and Kántás (7) as early as a decade ago. This assumption was proved by the boring of Szany, where a carbodoleritic rock was found in some two thousand metres depth in a locality of high magnetic anomaly. The evident difference between this magmatic mass and the one assumed by Girdler is that while the Red Sea mass is apparently parallel with the sea axis, our mass forms an angle of about 30 degrees with the Little Plain axis.

c) As pointed out by Egyed (1), the Rifts are characterized by high values of the terrestrial heat flow. As far as has been determined (in one point), this is not the case in the Little Hungarian Plain.

d) Seismic activity in the Rift area is high. It is almost lacking in the Little Hungarian Basin, although one of the most seismic areas of Hungary (which is aseismic in general, with severe shocks occurring at some decades' intervals) lies along one of the boundary faults of the area.

In summarizing all that has been said above, the Little Hungarian Basin and its southward extension, characterized by one of the thinnest crustal segments in Europe, show a number of features identical with or reminding of the great African rifts. The differences in sedimentary filling, heat flow and seismicity may be explained by the assumption that this area is older than the African rifts and presents an "extinct" variety of the same. Other differences in size and shape and in a number of smaller particulars are due to the fact that this feature of the Earth's crust occurs in an area of orogenic belts and cuts obliquely through a number of more ancient structural features, namely the faulted and overthrusted Mesozoic of the Bakony Mountains.

The above considerations give another proof that tensional zones in the crust are more frequent than generally believed (8).

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